SECA

Solid State Energy Conversion Alliance

mass produced ceramic fuel cells for low-cost power

WHAT IS SECA?

The Solid State Energy Conversion Alliance (SECA) comprises government agencies, commercial developers, universities, and national laboratories committed to the development of low-cost, high power density, solid state fuel cells for a broad range of applications. Industrial teams, research and development performers, and funding organizations are part of the alliance. SECA is being formed to accelerate the development of the industrial base needed to commercially produce low-cost solid state fuel cells in the near future. Two U.S. Department of Energy (DOE) national laboratories, the National Energy Technology Laboratory (NETL) and Pacific Northwest National Laboratory (PNNL), are the driving forces behind SECA, providing the leadership, focus, and integration needed to bring solid state fuel cell technology into near-term markets.

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A VISION FOR FUEL CELLS IN 2010

Low-cost, high-efficiency, solid state fuel cell systems will be available at less than $400/kilowatt (kW) for stationary applications and at even lower costs for transportation applications. This breakthrough will allow widespread penetration into high volume stationary and transportation markets, ultimately leading to the application of advanced fuel cell technology in Vision 21 central station power plants. The inherently high (60 to 70 percent) conversion efficiencies of these solid state fuel cells will provide significantly reduced CO_2 emissions and negligible emissions of other pollutants.

The basic building block will be a 5-kW solid state fuel cell module that can be mass-produced and used for residential or auxiliary power unit applications. The mass-produced 5-kW core modules will be combined like batteries for applications with larger power needs, thus eliminating the need for custom designed fuel cell stacks to meet a specific power rating. SECA technology will ultimately lead to megawatt size configurations for commercial/light industrial packages and Vision 21 central power station applications.

NETL

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

NEED FOR A NEW SOLID STATE FUEL CELL TECHNOLOGY

STATIONARY

- Existing fuel cell technologies are likely to plateau at a capital cost of $1,000 to $1,500/kW. Reduction below this plateau requires breakthrough developments for existing technologies.
- High-volume fuel cell applications will require a cost at or below $400/kW.
- Competing technologies have lower system efficiencies and environmental issues, such as NO_x production.

TRANSPORTATION

- Solid oxide technology offers potentially low system costs when operating on available fuels.
- Solid oxide fuel cell systems are readily adaptable to standard transportation fuels.
- Efficiencies of solid oxide fuel cell systems are very high. When closely coupled with high temperature on-board reforming, overall "wellhead-to-wheels" efficiency can be high.
- No other technologies offer both high efficiency and low emissions.

MILITARY

- Fuel logistics are critical to military applications. Seventy percent of military logistical deployment is the transportation of fuel; increased fuel efficiency will have a dramatic impact.
- There is a strong need for reliable high-efficiency, quiet power sources compatible with defense logistic fuels.
- Future ship propulsion systems will use electric drives and distributed power sources.

WHY NOW?

The stage for low-cost solid state fuel cell technology has been set. Recent breakthroughs in ceramic materials, fuel cell design, and manufacturing technology are converging. These include advances in thin-film capabilities with solid state fuel cell materials; high power density enabling innovations, such as anode supported cells; compact fuel processing technology; improvements in power electronics at the device level; and integration of manufacturing technology from related industries, such as the semiconductor industry.

Market forces are also playing an important role. Deregulation is favoring distributed generation technologies, such as fuel cells. In addition, the Department of Defense (DOD) recently committed to using electric drive for future ship propulsion systems, and it continues to embrace "dual use" technology development. Moreover, the utility and transportation industries, which are concerned with global impacts of carbon emissions, are exploring advanced technology solutions that will permit the continued use of fossil fuels for the foreseeable future.

WHY A NEW SOLID STATE FUEL CELL TECHNOLOGY?

Solid state fuel cell technology as the basic building block for multiple applications offers several advantages. It offers inherently high efficiency – 60 to 70 percent in individual systems and up to 80 percent in staged or hybrid systems. It can handle available liquid fuels, such as gasoline and diesel. High-temperature solid state fuel cells couple easily with the high-temperature reformation of liquid fuels. Solid state fuel cells have simple and efficient heat removal designs when operated at high power densities, an important advantage for compact systems. Planar solid state fuel cells can produce the very high power densities needed to meet tough size/weight requirements needed for stationary, transportation, and military markets. Finally, solid state components can be fabricated with advanced manufacturing technology much like computer chips.

SECA: THE SOLID STATE ENERGY CONVERSION ALLIANCE

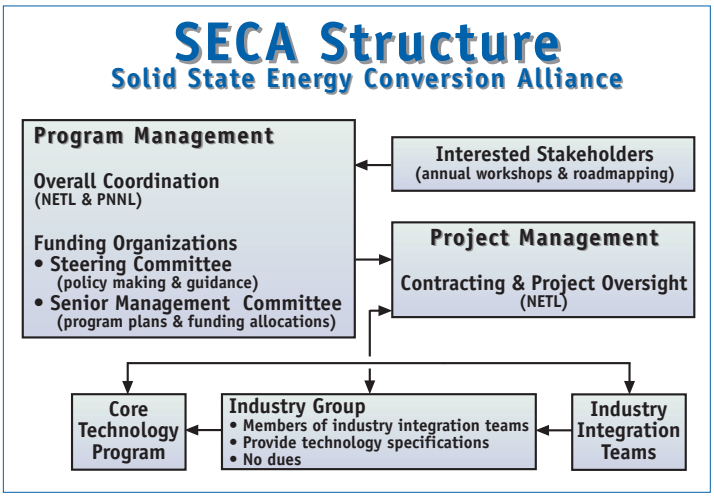
The DOE's Office of Fossil Energy and NETL have committed to building an alliance of government agencies, commercial developers, universities, and national laboratories to develop solid oxide fuel cells with the capability for immediate commercial success.

SECA will represent a new model for joint government and private industry technology development. The structure of SECA was designed to leverage resources to overcome the most difficult technology barriers, while enabling private partners to maintain a competitive position.

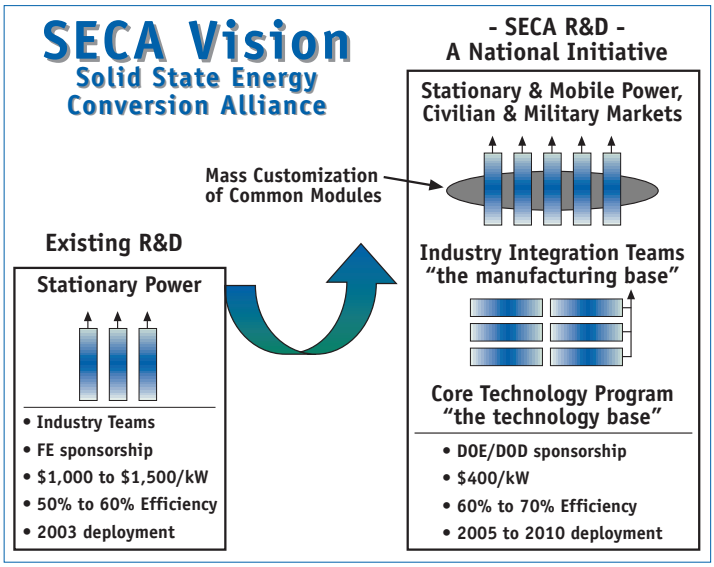
SECA will be structured into "vertical" industrial development teams, and a core "horizontal" or crosscutting technology program consisting of universities, national laboratories, and other research-oriented organizations. A government-led project management team will coordinate both activities.

NETL serves as the executive or managing member for the alliance, acting on behalf of all the federal agencies in SECA.

The vertical industrial teams will be selected on the basis of a program solicitation. The solicitation will invite teams to participate in a collaborative, cofunded effort to develop fuel cells and to develop the industry infrastructure necessary to produce them at competitive cost.



The alliance requires commitment to the concept of mass customization as a route to significant reductions in the cost of fuel cells, but clearly establishes responsibility for commercialization decisions with the systems developers. Each team is responsible for meeting the market requirements for its targeted customers. The teams will have available to them the common technologies, design elements, and materials needed in order to achieve breakthrough performance.



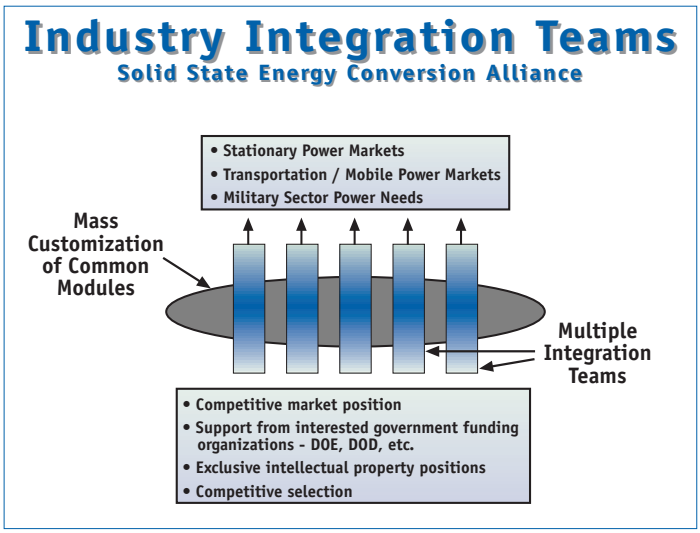
SECA LEADERSHIP

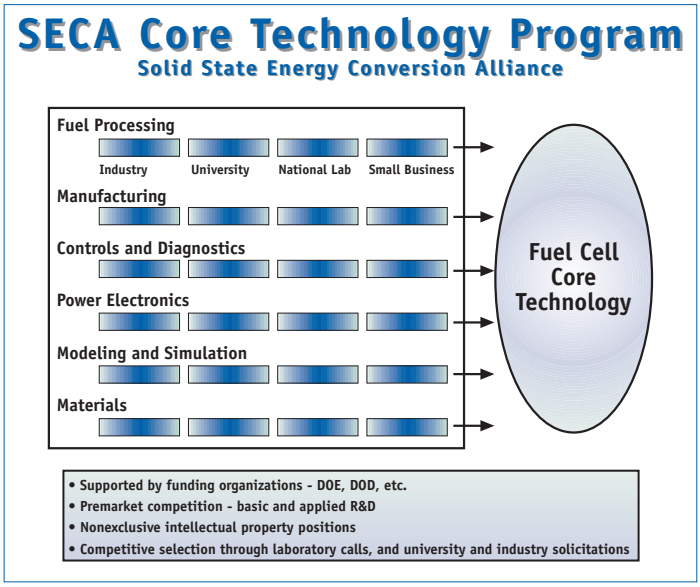
NETL was recently designated as DOE's newest national laboratory and as the new Strategic Center for Natural Gas. In this role, NETL has formed a strategic partnership with its sister national laboratory, PNNL, to establish SECA. This partnership is well-positioned to bring industry, universities, and other national labs together to achieve the SECA goals. NETL has the solid state fuel cell technology background and has led fuel cell development through three generations of technology. PNNL research in advanced fuel cell materials and thermal systems has provided a solid foundation for achieving breakthrough performance targets. NETL and PNNL collectively have decades of experience in forming and managing collaborative research with industry.

SECA ORGANIZATION

Independent industrial integration teams will develop the fuel cell manufacturing capability and the packaging needed for different markets. The number of teams will depend on the number of government sponsors and level of commitment from each sponsoring agency.

In addition, the core technology program will be assembled by NETL and PNNL using standard government project management practices to focus universities, national laboratories, and other research agencies toward finding solutions to the crosscutting technical barriers identified by the vertical industry teams. Substantial funding will be committed to the core technology program. The program will consist of individual organizations working under the direction of a NETL-led project management team.





BREAKTHROUGH TECHNOLOGY DEVELOPMENT

Annual workshops will be conducted to seek public input in developing the program and technology roadmap. A steering committee comprising members of the vertical industry integration teams will provide input to the NETL-led project management team. The project management team will engage the core technology program to address the crosscutting technology needs.

PUBLIC BENEFITS

If advanced ultraclean fuel cell technology can move from niche markets to widespread use in stationary power and transportation applications, the high efficiency (typically double that of existing options) will result in significantly reduced emissions for all sectors. It will mean that we are "greener sooner" using fossil fuels. SECA's approach leverages federal R&D investments across multiple agencies and forces national program integration internal to DOE and external to other agencies. In addition to the environmental benefits, distributed power can provide enhanced grid stability and reliability. Positioning our industrial base to be first to market with low-cost fuel cell technology will enhance U.S. competitiveness in global markets. Ultimately, in central station Vision 21 applications, we will be able to continue to use our low-cost available domestic energy resources in an environmentally acceptable way.

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